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Similarity in the feeding ecology of parrotfish (Scaridae) in coral reef habitats of the Malaysian South China Sea, as revealed by fatty acid signatures

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ABSTRACT

To understand the trophic ecology and habitat use of coral reef fish, the fatty acid composition and levels were examined in three species of parrotfish, *Scarus psittacus*, *Scarus quoyi* and *Scarus rivulatus*, which were collected at the Bidong Island of the Malaysian South China Sea. The proportions of saturated fatty acids (SAFA) are 57.6–64.9%, where fatty acids have the highest proportion, monounsaturated fatty acids (MUFA) (25.3–25.9%) have the second highest proportion, and polyunsaturated fatty acids (PUFA) (9.2–17.1%) have the lowest proportion. Palmitic acid (C16:0) is the most common acid in SAFA, palmitoleic acid (C16:1) is the dominant acid in MUFA, and eicosatrienoic acid (C20:3n3) and eicosapentaenoic acid (EPA, C20:5n3) have the highest proportions in PUFA. The composition of each fatty acid does not differ among species, which suggests that the feeding ecology and habitat use of the fish in the coral reef ecosystem are similar. The fatty acid concentrations, particularly that of PUFA, increase with the fish growth, which suggests that the diet and habitat shift during the life history of the fish. The diet shifts revealed by the fatty acid composition and levels suggest the similarity in habitat use and feeding ecology of those types of parrotfish.

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1. Introduction

Coral reefs in Southeast Asia are extremely rich and diverse and are recognized as a hot spot in the world because 34% of coral reefs on earth are found in that area (Burke et al., 2002). In particular, several corals and rich coral reefs are distributed in the South China Sea. Malaysia has one of the most richly diverse fish populations in the world (Arai, 2014). Although marine fish in the Malaysian China Sea are highly abundant and diverse, few studies have focused on their life history, ecology and reproduction compared to other coral reef areas in the Indo-Pacific.

Research on the feeding ecology and trophic position of coral reef fish can provide basic knowledge for understanding the life history, habitat use and ecology of the fish. This information also increases our understanding of the interaction between corals and fish in coral ecosystems because some coral reef fish, such as parrotfish directly graze the corals. Understanding the effects of coral predators on the reefs helps protect and conserve the coral ecosystems. Recently, the signature of fatty acid

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analysis has been widely applied to study the diet and feeding ecology of various marine species (e. g., Daly et al., 2010; Stowasser et al., 2012; Couturier et al., 2013). The use of fatty acids as trophic biomarkers is based on the assumption that many fatty acids in the marine environment are characteristic of specific groups (Stowasser et al., 2012). These fatty acids can generally not be synthesized in higher trophic levels and are incorporated with a low turnover rate (Sargent et al., 1987). Thus fatty acid signatures and profiles reveal the dietary origin of the target species.

Parrotfish (Scaridae) include approximately 85 tropical and subtropical reef fish species and are known as reef herbivores and detritivores (Randall et al., 1997; Bonaldo et al., 2006). The fish are known to change sex and colour during their lifetime and growth as protogynous hermaphrodites. Thus, several studies have been conducted regarding the behaviour, function and physiology in Indo-Pacific coral reefs (e. g., Bonaldo et al., 2006; Bonaldo and Bellwood, 2008). However, even in these studies, the fundamental ecology and biology of the life history, migration and feeding ecology of the fish have scarcely been understood in the Malaysian South China Sea despite their high abundance in the area (Arai, 2014).

In the present study, fatty acids were examined to understand the trophic ecology of three species of parrotfish: *Scarus psittacus*, *Scarus quoyi* and *Scarus rivulatus*, which were collected at Bidong Island of the Malaysian South China Sea. To understand the trophic position in accordance with growth, the fatty acid signatures were compared using various size class samples.

2. Materials and methods

2.1. Fish

Three species of parrotfish (*S. psittacus*, *S. quoyi* and *S. rivulatus*) were collected at Bidong Island of the South China Sea, Malaysia (latitude: 5.62°; longitude: 103.07°) between 27 and 28 October 2014 (Fig. 1). Bidong Island is located off Terengganu State on the east coast of Peninsular Malaysia, which is known for its history as a Vietnamese refugee settlement. The island also comprises well-developed coral reef ecosystems that contain various coral- and rocky-reef-associated fish (Matsunuma et al., 2011). All of the fish were collected using fishnets. After collection, all of the fish were immediately stored in ice chests, brought back to the laboratory, maintained in a –20 °C freezer and used for the fatty acid analyses within one month. In total, 14 fish samples were measured to obtain the total length (TL) and body weight (BW): each fish was dissected, and the liver and gonad were removed to determine their weights (Table 1). The stomach of each fish was dissected for the content analyses. The gonadosomatic index (GSI) of each fish was calculated using the formula

$$\text{GSI} = \text{GW} \text{BW}^{-1} \times 100$$

2.2. Fatty acid analysis

The liver samples of three species of parrotfish were analysed to obtain the fatty acid composition via a one-step method (Bachok et al., 2006; Abdulkadir and Tsuchiya, 2008). Three replicates of each liver were mixed with 4 ml of hexane and 1 ml

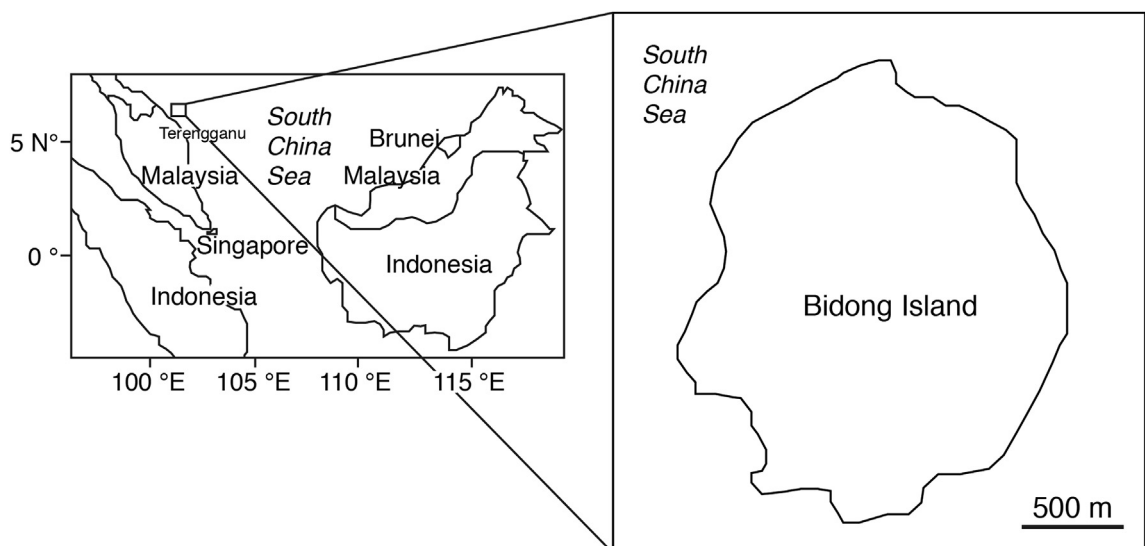


Fig. 1. Map of the location of the study site at Bidong Island in the Malaysian South China Sea, off the Terengganu State in the east coast of Peninsula Malaysia.

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